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Baird

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(54) **ELECTRO-MAGNETIC ENGINE WITH PIVOTING PISTON HEAD**

(71) Applicant: **Magtricity, LLC**, Ada, OK (US)

(72) Inventor: **Jeffery D. Baird**, Ada, OK (US)

(73) Assignee: **Magtricity, LLC**, Ada, OK (US)

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Related U.S. Application Data

(63) Continuation of application No. 13/116,713, filed on May 26, 2011, now Pat. No. 8,866,350, which is a continuation of application No. PCT/US2009/065908, filed on Nov. 25, 2009.

(60) Provisional application No. 61/232,109, filed on Aug. 7, 2009, provisional application No. 61/118,295, filed on Nov. 26, 2008.

(51) **Int. Cl.**

H02K 33/00	(2006.01)
H02K 53/00	(2006.01)
H02K 7/075	(2006.01)

(52) **U.S. Cl.**

CPC ***H02K 7/075*** (2013.01); ***H02K 33/00*** (2013.01); *H02K 53/00* (2013.01); *Y10S 74/09* (2013.01)

(58) **Field of Classification Search**

CPC H02K 7/075; H02K 53/00
USPC 310/24, 37
See application file for complete search history.

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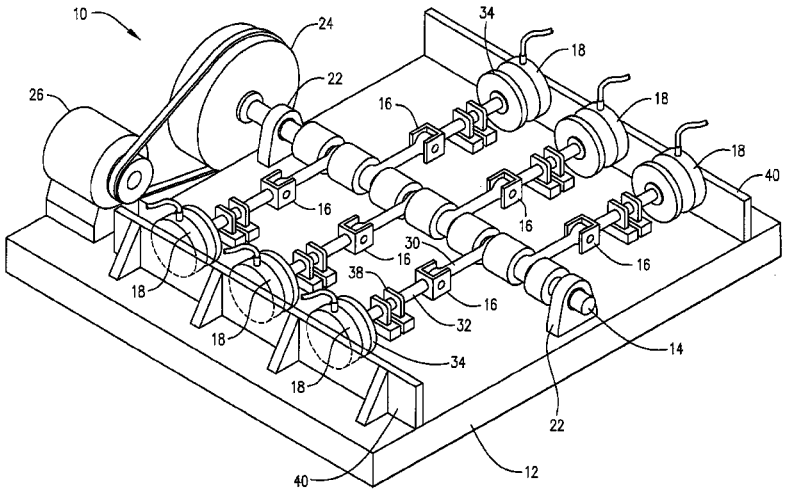
Primary Examiner — Terrance Kenerly
(74) *Attorney, Agent, or Firm* — Dunlap Codding, P.C.

(57) **ABSTRACT**

An electromagnetic engine including a plurality of pistons and a plurality of corresponding electromagnets. The pistons are each connected to a crankshaft and fabricated of a ferrous material. The electromagnets are spaced from the pistons in alignment therewith. An electrical power source is provided to power the electromagnets, and a control assembly is provided to control the sequence of energizing the electromagnets, so that by energizing the electromagnets, the pistons will be pulled toward the electromagnets in response to a timely applied electromagnetic field. The force imparted on the piston is transmitted by the rod to the crankshaft, which provides power via an output shaft for desired uses.

8 Claims, 7 Drawing Sheets



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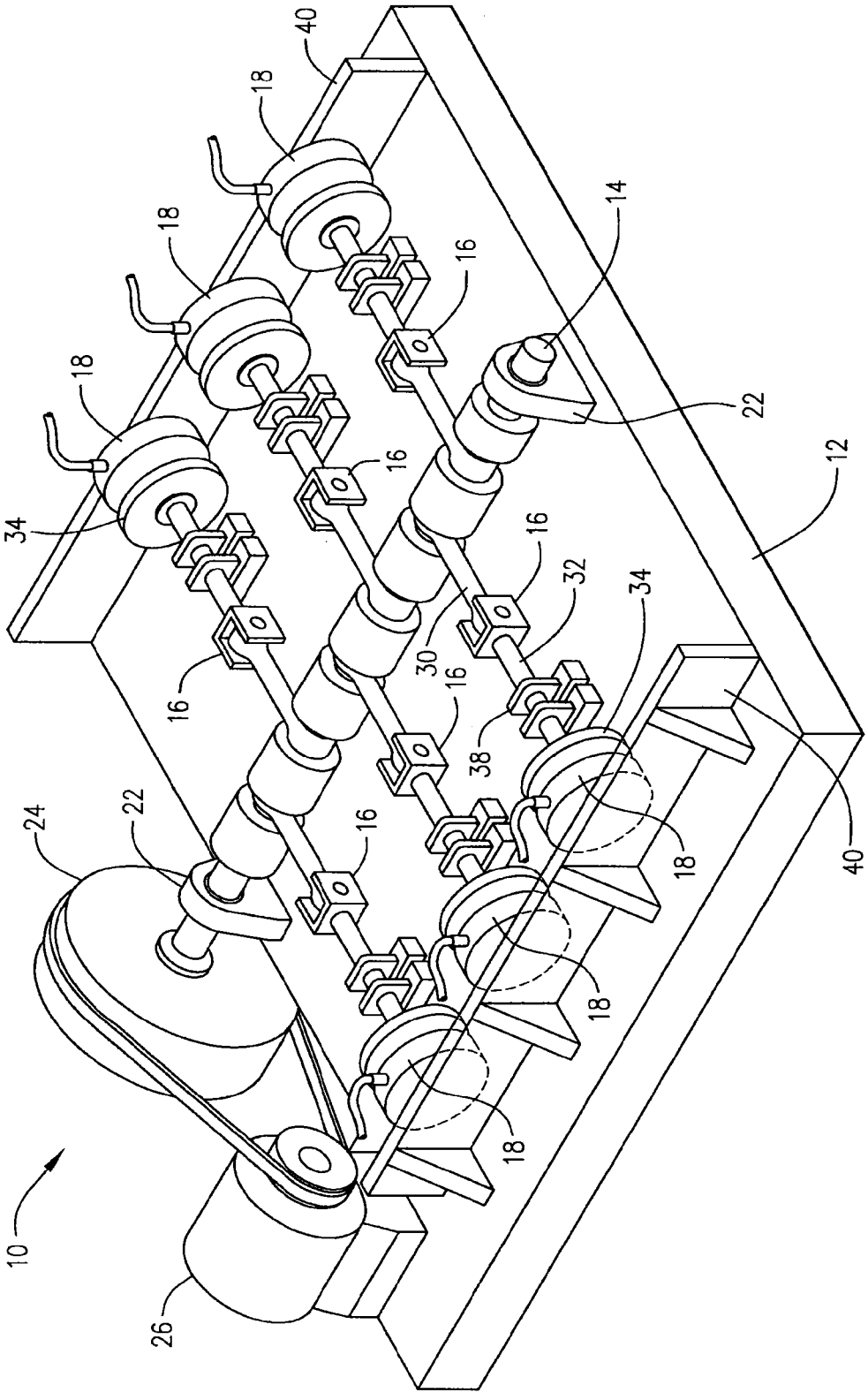

FIG. 1

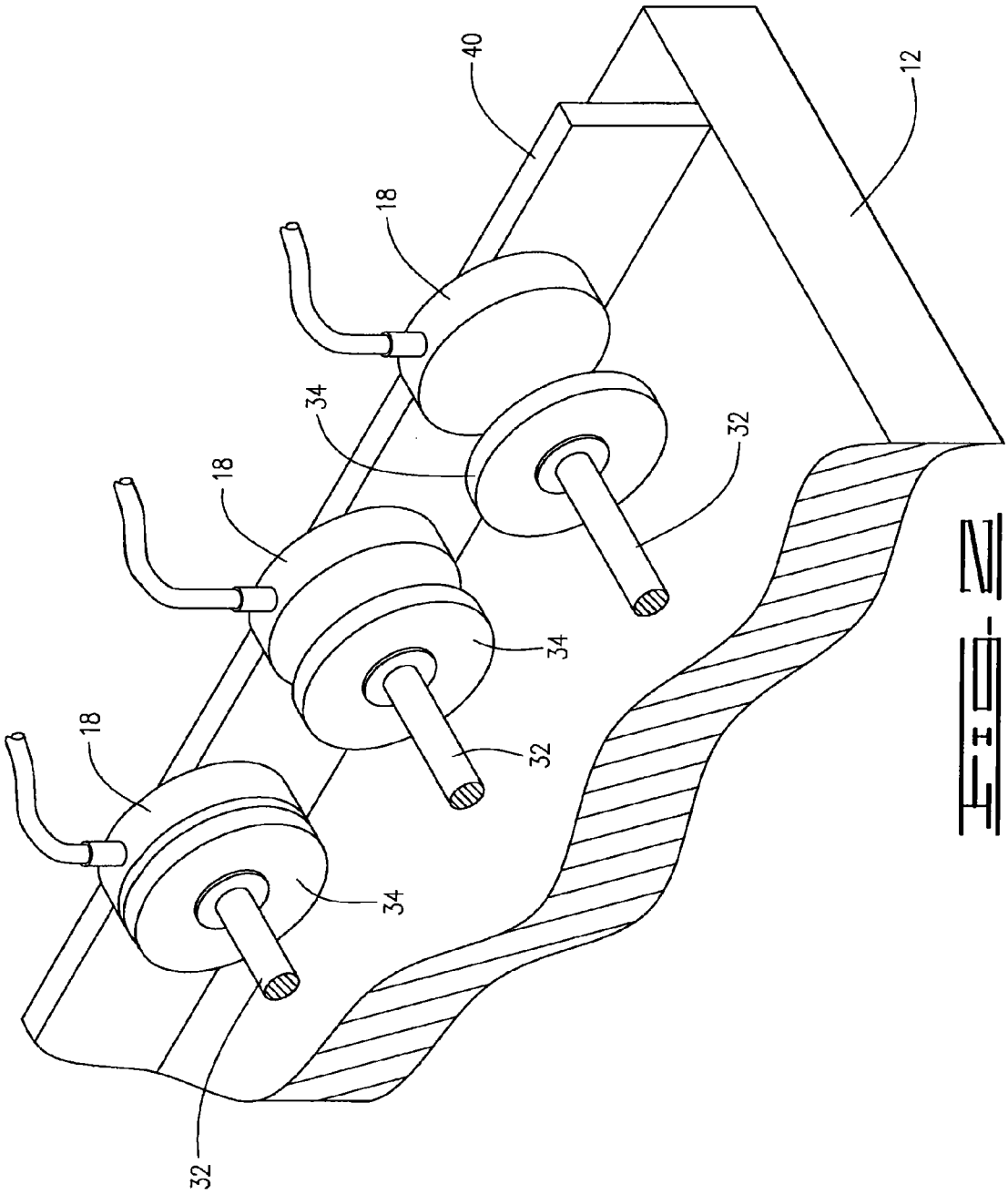

FIG. 2

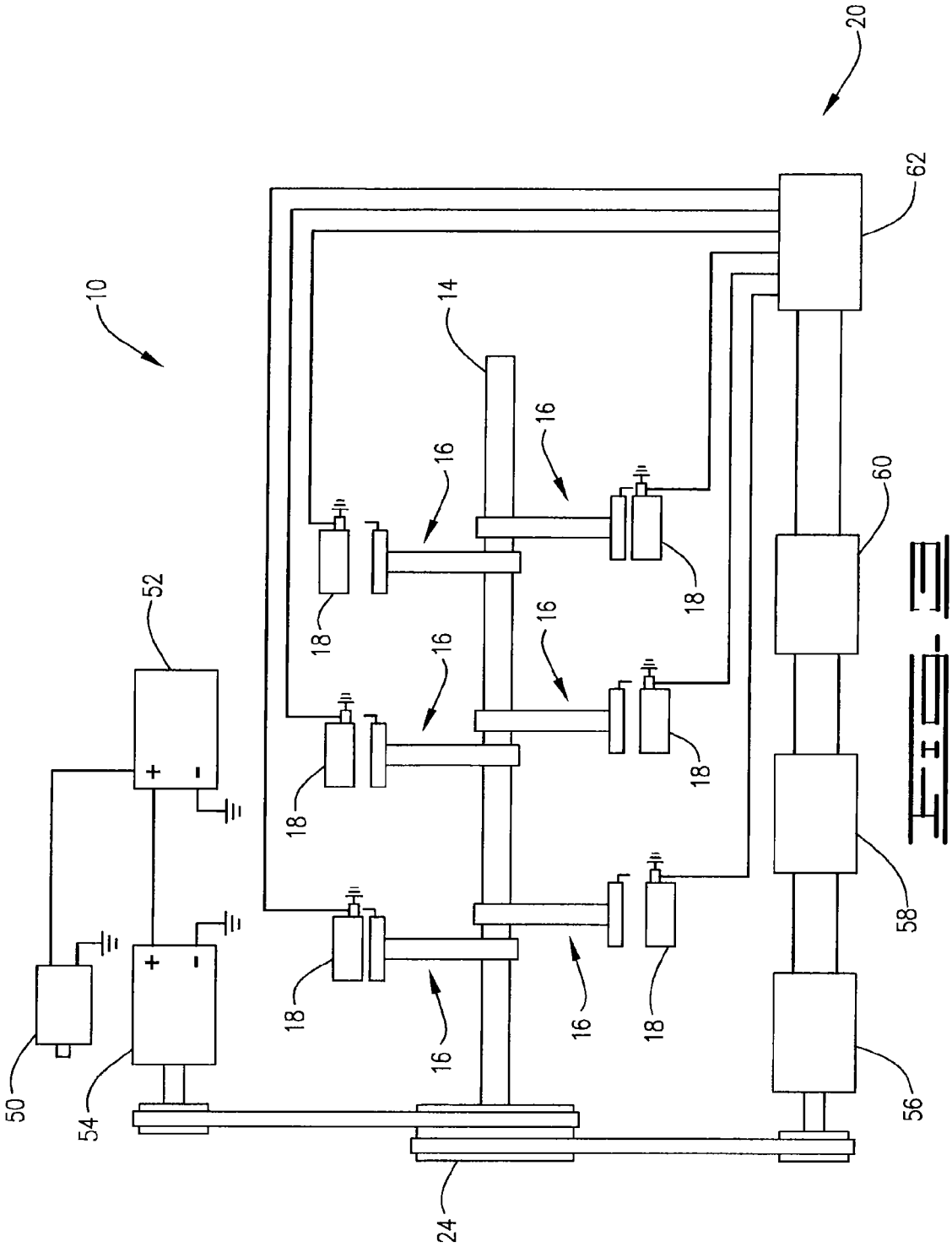

FIG. 3

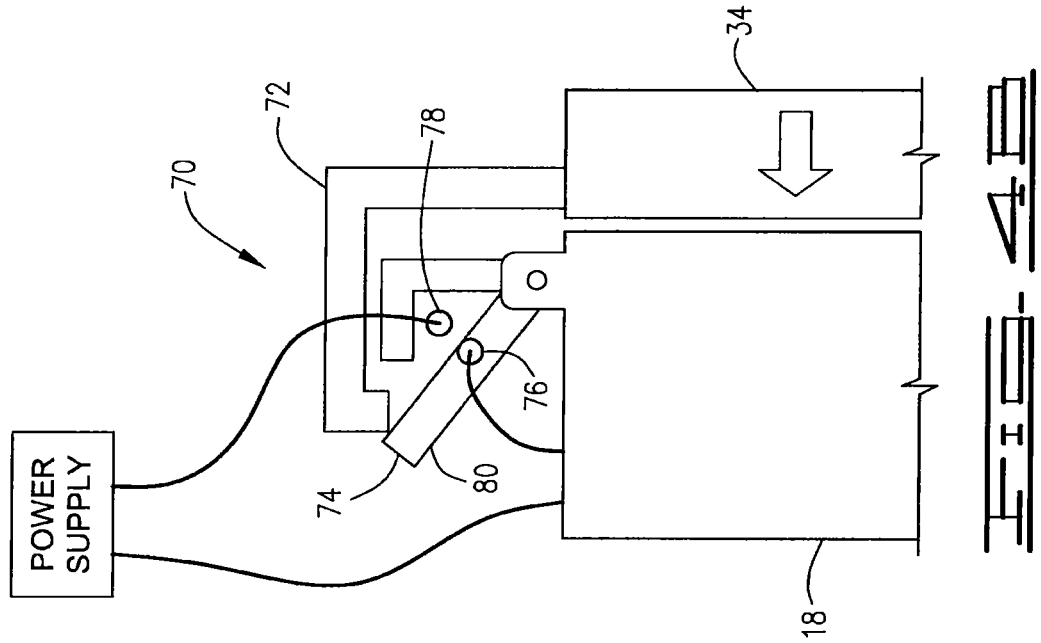
34
72
78
70
POWER SUPPLY
76
74
80
18

FIG. 4B

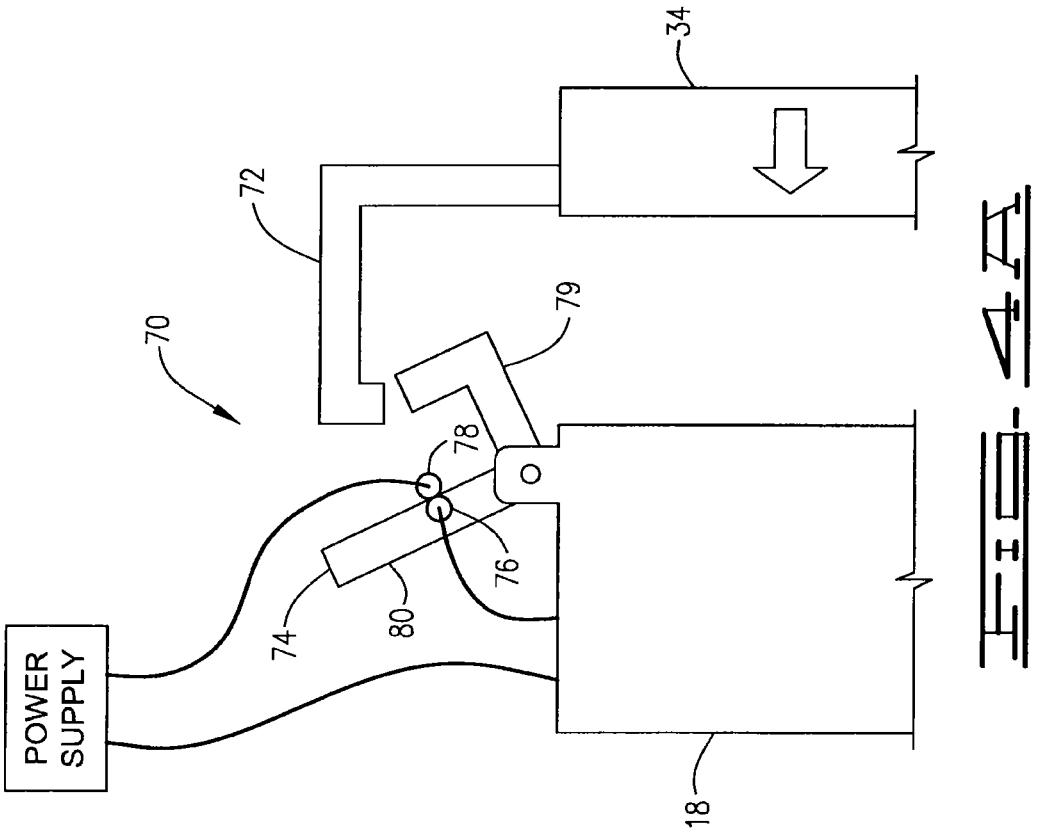
34
72
79
70
78
POWER SUPPLY
76
74
80
18

FIG. 4A

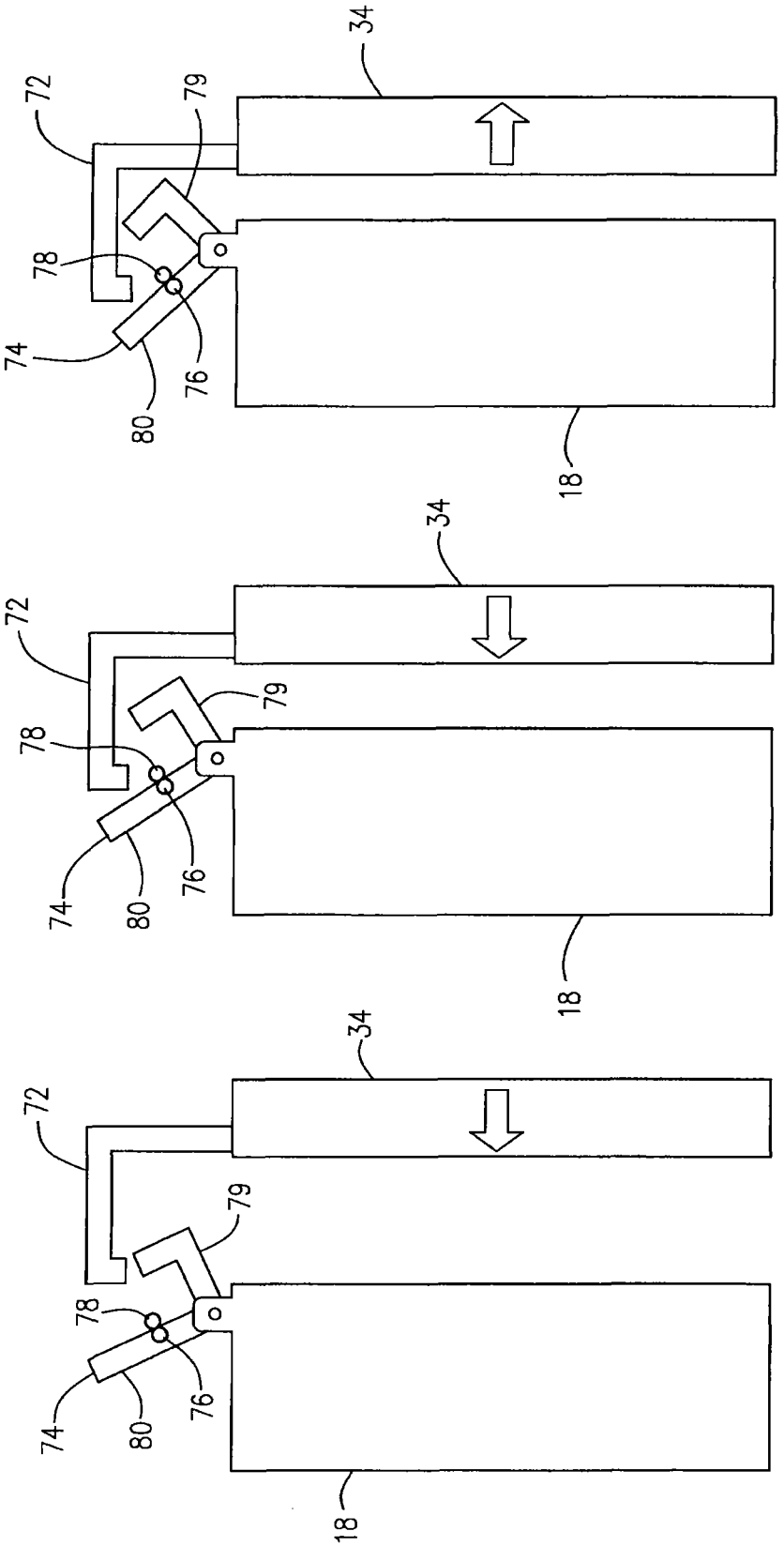

FIG. 5C FIG. 5B FIG. 5A

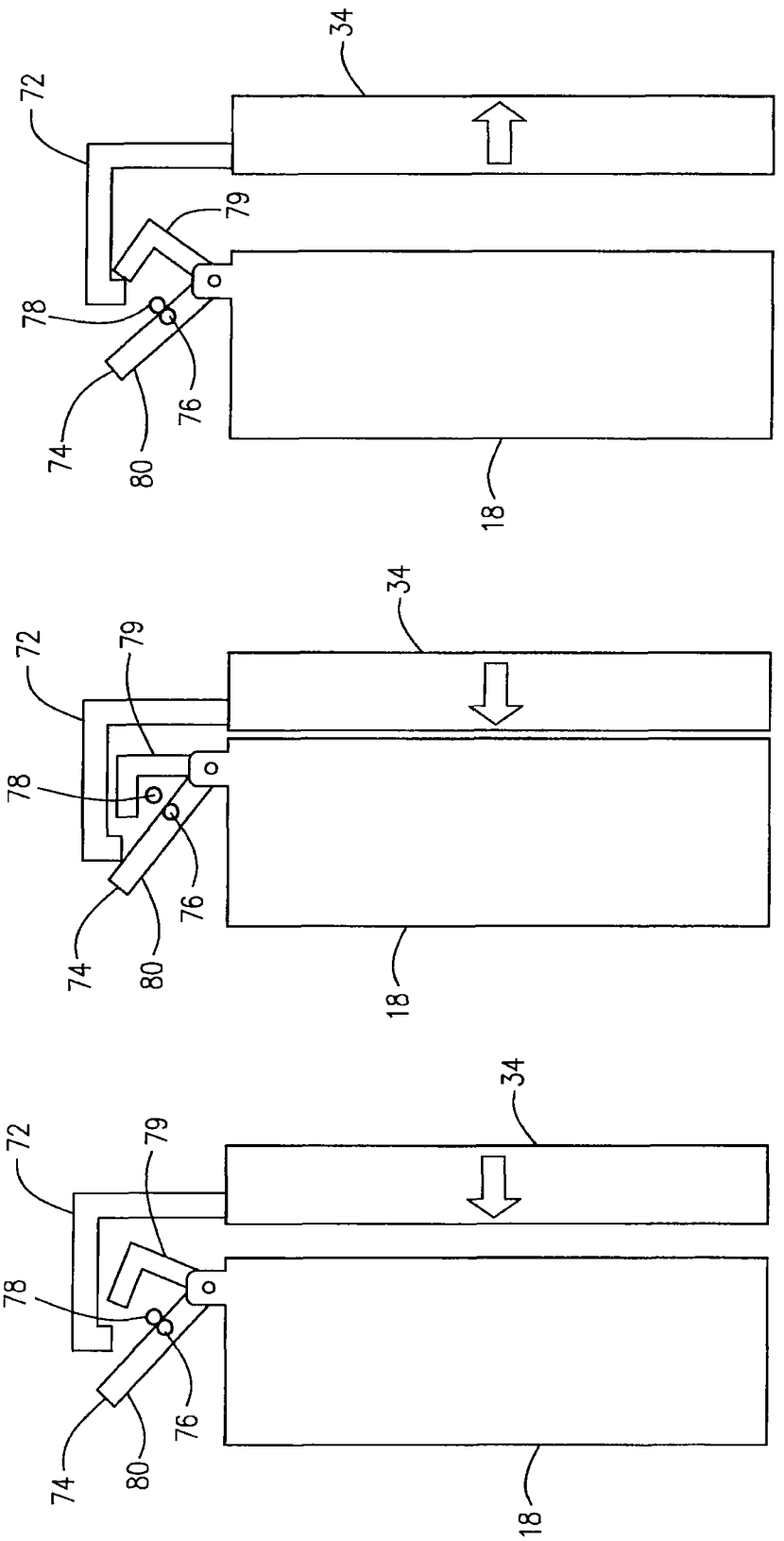

FIG. 5E

FIG. 5F

FIG. 5G

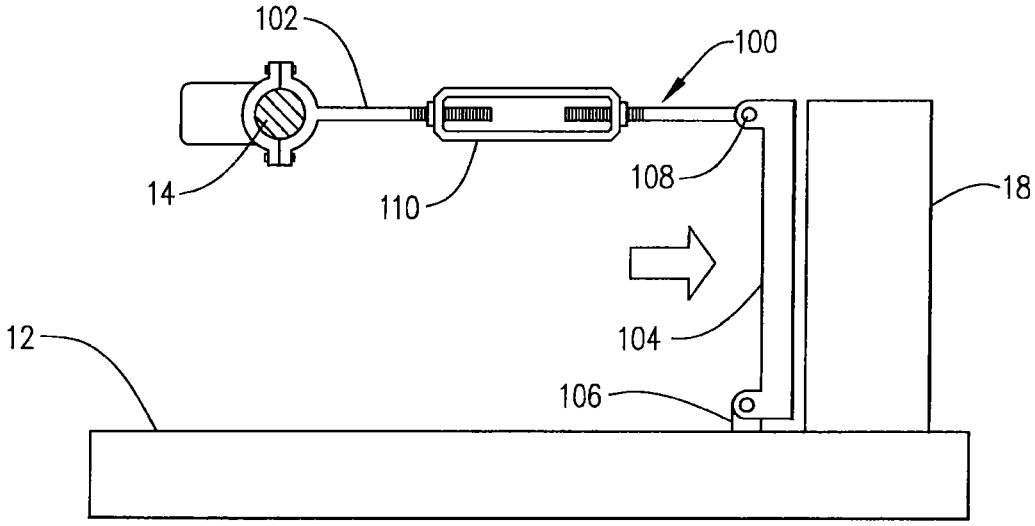

FIG. 6

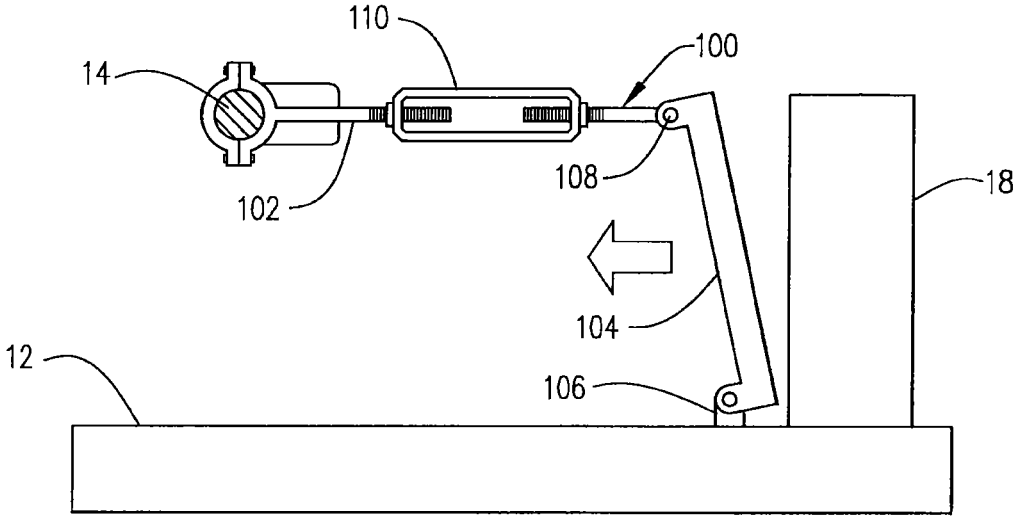

FIG. 7

ELECTRO-MAGNETIC ENGINE WITH PIVOTING PISTON HEAD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 13/116,713, filed May 5, 2011, which claims the benefit of PCT application Ser. No. PCT/US09/65908, filed Nov. 25, 2009, which claims the benefit of U.S. Provisional Application Ser. No. 61/232,109, filed Aug. 7, 2009, and U.S. Provisional Application Ser. No. 61/118,295, filed Nov. 26, 2008, the contents of each being incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to a reciprocating electromagnetic engine, and more particularly, but not by way of limitation, to a magnetically driven engine for developing shaft power.

2. Brief Description of Related Art

The creation of magnetic energy by electricity is well known in the art. One of the most prevalent uses of such energy is electric motors. The direct use of such energy, however, is somewhat limited in industry to those applications where, for example, the magnetic attraction forces are used to lift objects or to separate magnetic particles from compounds containing both magnetic and nonmagnetic particles. A more prevalent direct use of magnetic energy is found wherever electrical solenoids are used. Such usage comprises making and breaking electrical contacts, opening and closing valves, and hot-melt glue guns or other such applications where a predetermined amount of a product is dispensed upon demand or at specific time intervals. More recently, the field created by magnetic energy has been used in particle acceleration devices such as cyclotrons and synchrotrons.

The fascination associated with the potential uses of magnetic energy has led to a number of devices other than the above, whereby electrical energy is converted into magnetic energy which is then converted into mechanical rotational motion. These devices are generally known as electromagnetic engines. They differ from the common electric motor in that they contain one or more pistons attached to a crankshaft which provides the mechanical output. In light of the number of attempts to produce an electromagnetic engine, there is an obvious need to effectively increase the power output and the efficiency of electromagnetic engines before they can, in fact, be considered to be competitive with other engines and motors such as electric motors and internal combustion engines. Moreover, based on the noncommercial use of such engines, the need for an electromagnetic engine having a high efficiency coupled with a high power output still exists today. It is to such an apparatus that the present invention is directed.

SUMMARY OF THE INVENTION

The present invention is directed to an electro-mechanical engine for automotive or other use. An electromagnetic engine is provided with a plurality of pistons and a plurality of corresponding electromagnets. The pistons are each connected to a crankshaft and fabricated of a ferrous material. The electromagnets are spaced from the pistons in alignment therewith. An electrical power source is provided to power the electromagnets, and a control assembly is provided to control the sequence of energizing the electromagnets, so that by energizing the electromagnets, the pistons will be pulled toward the electromagnets in response to a timely applied electromagnetic field. The force imparted on the piston is transmitted by the rod to the crankshaft, which provides power via an output shaft for desired uses.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of an electromagnetic engine constructed in accordance with the present invention.

FIG. **2** is a perspective view of a portion of the electromagnetic engine of the present invention.

FIG. **3** is a schematic view of a power distribution system.

FIGS. **4**A and **4**B are elevational views of a switch associated with a piston head and a corresponding electric magnet.

FIGS. **5**A-**5**F are elevational views of the switch showing a sequence of operation.

FIG. **6** is a side elevational view of another embodiment of a piston assembly shown at the top of its stroke.

FIG. **7** is a side elevational view of the piston assembly of FIG. **6** shown at the bottom of its stroke.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Referring to FIGS. **1**-**3**, an electromagnetic engine **10** constructed in accordance with the present invention is shown. Broadly, the electromagnetic engine **10** includes a support structure **12**, such as a frame or housing, a crankshaft **14** journaled to the support structure **12**, at least one piston assembly **16** operably connected to the crankshaft **14**, at least one electric magnet **18** for imparting reciprocating mechanical energy to the piston assembly **16** which in turn is translated into rotational motion of the crankshaft **14**, and a power distribution system **20** (FIG. **3**) for selectively energizing and de-energizing the electric magnet **18**.

The support structure **12** may be manufactured of any non-magnetically interfering composition, such as a non-ferrous material like a high strength plastic, ceramic, or aluminum. The support structure **12** may be in the form of a frame or base, as illustrated, so as to provide an open faced platform to reduce friction and heat related issues. However, the support structure may take the form of any functional structure, such as a more traditional engine block.

The crankshaft **14** is rotatably connected to the support structure **12** with a plurality of bearings **22**. One end of the crankshaft **14** is provided with a pulley **24** for translating the rotational motion imparted to the crankshaft **14** to a load source, such as a generator **26**. Although not shown, the pulley **24** may be provided with counterbalance weights for storing and releasing energy. The crankshaft **14** is shown to be a conventional six-cylinder crankshaft; however, it will be appreciated that a variety of crankshaft designs may be utilized.

The engine **10** is shown to include a plurality of piston assemblies **16**. Each of the piston assemblies **16** has a piston arm **30**, a piston rod **32**, and a piston head **34**. One end of the piston arm **30** is journaled to the crankshaft **14** in a conventional manner and the other end of the piston arm **30** is pivotally connected to the piston rod **32**. The piston rod **32** is reciprocally supported on the support structure **12** by a piston rod housing or sleeve **38**. The piston head **34** is connected to the distal end of the piston rod **32** and manufactured of a ferrous material, such as iron or steel.

The electric magnets **18** are mounted to the support structure **12** so that the electric magnets **18** are axially aligned with

a corresponding piston head **34** and maintained in a spaced apart relationship with respect to such piston head **34** so that the magnetic fields created by the electric magnets **18** provide an attractive force which tends to pull the piston assembly **16** toward the electric magnet **18**. The electric magnets **18** are shown to be mounted to the support structure **12** with a magnet mount **40** in a flat arrangement to provide for a low profile engine. However, it will be appreciated that other mounting arrangements such as V-shaped, inline, or radial are also possible, as well as any other arrangement that is capable of imparting rotational motion to the crankshaft **14**.

The operation of the engine **10** is described by reference to the stroke of a piston assembly **16**. In one embodiment, the electric magnet **18** is energized so as to create an attractive force which pulls the piston assembly **16** toward the electric magnet **18**. As the piston head **34** reaches the top of its stroke, the electric magnet **18** is de-energized. To take advantage of the full attractive force of the electric magnet **18**, the electric magnet **18** is preferably positioned so that the electric magnet **18** is near the piston head **34** when the piston assembly **16** is at the top of its stroke (sometimes referred to as "top dead center"). By way of example, with a piston assembly that has a three inch stroke, the electric magnet may be spaced from the piston head a distance of about 1/16 of an inch when the piston assembly is at the top of its stroke. Such a distance is small enough for the piston head to receive the full attractive force of the electric magnet, yet great enough to avoid the electric magnet interfering with the reciprocating movement of the piston assembly.

At some point after the piston assembly **16** begins its return stroke, the electric magnet **18** must be energized again by the power distribution system **20** to repeat the stroke cycle. While the "firing" sequence for the energizing and de-energizing of the electric magnets are critical to the operation of prior art electromagnetic engines, the engine **10** attempts to avoid the problems encountered when attempting to precisely time the energizing and de-energizing.

Referring now to FIG. **3**, the power distribution system **20** is broadly illustrated as including a starter switch **50**, a low voltage power source **52**, such as a 12 or 24 volt battery, and a starter motor **54** operatively connected to the crankshaft **14** for actuating the engine **10**. The power distribution system **20** further includes a generator **56** operably connected to the crankshaft **14**. The generator **56** may be used to power an AC power bank **58**. The generator **56** is also connected to an AC/DC converter **60** which is connected to a manifold **62**. The manifold **62** is electrically connected to each of the electric magnets **18**.

The precise timing of the actuation of the electromagnets has been the subject of prior art references. In an attempt to avoid such issues, the electric magnets **18** preferably remain energized throughout the stroke with the exception of when the pistons are near or at top dead center and for a distance during the return stroke.

Referring now to FIGS. **4** and **5**, the power distribution system **20** is shown to further include a switch **70** associated with each piston head and electric magnet combination. The switch includes a piston push arm **72** extending from the piston head **34** and a V-switch **74** provided with a contact plate **76** and pivotally connected to the electric magnet **18**, and a hot contact member **78**. As best shown in FIGS. **4**A and **5**B, the contact plate **76** is electrically connected to the electric magnet **18**, while the hot contact member **78** is electrically connected to a power source or manifold.

As demonstrated in FIGS. **5**A-**5**F, with the contact plate **76** in electrical communication with the hot contact member **78**, the electric magnet **18** is energized. As such, the piston head **34** is pulled toward the electric magnet **18**. As the piston head **34** is pulled toward the electric magnet **18**, the piston push arm **72** will bypass a first leg **79** of the V-switch **74** and contact a second leg **80**. As the piston head **34** continues toward the electric magnet **18**, the V-switch **74** will be rotated thereby causing the contact plate **76** of the second leg **80** to disengage from the hot contact member **78** and in turn de-energize the electric magnet **18**. As the piston head **34** begins the return stroke (FIG. **5**F), the piston push arm **72** will travel a distance and then catch the first leg **79** of the V-switch **74** so as to cause the V-switch **74** to rotate and cause the contact plate of the second leg **80** to electrically contact the hot contact member **78** and re-energize the electric magnet **18**.

It should be appreciated that the power distribution system **20** may be any suitable system for energizing and de-energizing the electric magnets **18** in a predetermined sequence. For example, a suitable power distribution system **20** may include a cam provided on the crankshaft **14** that actuates a series of switches (e.g., proximity switches) in a desired sequence. It should also be appreciated that the number of piston assemblies that may be employed in the engine **10** may be varied. In addition, the moving parts may be lubricated in any conventional manner, such as a drip oil system or a pressure oil system.

FIGS. **6**-**7** illustrate another embodiment of a piston assembly **100**. The piston assembly **100** includes a piston rod **102** and a piston head **104**. The piston head **104** is supported on the support structure **12** such that the piston head **104** travels along an angular path between the top of its stroke or at a top dead center (FIG. **6**) and the bottom of its stroke (FIG. **7**). In the embodiment shown herein, a lower end of the piston head **104** is pivotally connected to the support structure **12** with a hinge **106**, or any other suitable pivot connector, so that the piston head **104** is in a face-to-face relationship with the electric magnet **18** when the piston head **104** is at the top of its stroke (FIG. **6**) and angularly disposed relative to the electric magnet **18** otherwise, with the maximum angular displacement taking place at the bottom of the stroke. In addition, the piston head **104** preferably is positioned near the electric magnet **18** when the piston head **104** is at the top of its stroke in a manner similar to that described above in reference to the piston assembly **16**.

The piston rod **102** has one end journaled to the crankshaft **14** in a conventional manner. The other end of the piston rod **102** is pivotally connected to the piston head **104** with a hinge **108**, or any other suitable pivot connector, so that the piston rod **102** transmits a rotational force to the crankshaft **14** in response to the angular movement of the piston head **104**. To maximize stroke length, the piston rod **102** is pivotally connected to the piston head **104** at a location diametrically opposed to where the piston head **104** is pivotally connected to the support structure **12**. However, it should be appreciated that the piston rod **102** may be attached to the piston head **104** at any location to achieve a desired stroke length.

The piston rod **102** may be constructed such that its length is adjustable. To this end, the piston rod **102** may be provided with a turnbuckle assembly **110** (FIGS. **6** and **7**) or any other suitable adjustment mechanism. In addition, because the piston rod **102** is pivotally connected to the piston head **104**, the piston rod **102** is not required to be reciprocally supported on the support structure **12**.

From the above description it is clear that the present invention is well adapted to carry out the objects and to attain the advantages mentioned herein as well as those inherent in the invention. While presently preferred embodiments of the invention have been described for purposes of this disclosure, it will be understood that numerous changes may be made

which will readily suggest themselves to those skilled in the art and which are accomplished within the spirit of the invention disclosed and as defined in the appended claims.

What is claimed is:

1. An engine, comprising:

a support structure;

at least one electric magnet connected to the support structure;

a crankshaft rotatably connected to the support structure; and

at least one piston assembly having one end operably connected to the crankshaft and a second end positioned in a spaced apart relationship to the electric magnet such that a magnetic field created by the electric magnet when the electric magnet is selectively energized provides an attractive force which pulls the piston assembly toward the electric magnet so as to impart reciprocating mechanical energy to the piston assembly;

wherein the piston assembly comprises:

a piston rod having a first end and a second end, the first end journaled to the crankshaft; and

a piston head fabricated of a ferrous material, the piston head pivotally connected to the second end of the piston rod to define a first pivot point and pivotally connected to the support structure to define a second pivot point such that the piston head travels between a first position and a second position along an angular path about the second pivot point.

2. The engine of claim **1**, wherein the support structure is a platform having an open upper face, and wherein the crankshaft is connected to the open upper face of the platform.

3. The engine of claim **1**, wherein in the first position the piston head is in a face-to-face relationship with the electric magnet and wherein in the second position the piston head is angularly disposed relative to the electric magnet.

4. The engine of claim **3**, wherein the piston rod is pivotally connected to the piston head at a location diametrically opposed to where the piston head is pivotally connected to the support structure.

5. An engine, comprising:

a support structure;

a plurality of electric magnets connected to the support structure;

a crankshaft rotatably connected to the support structure; and

a plurality of piston assemblies, each piston assembly having one end operably connected to the crankshaft and a second end positioned in a spaced apart relationship to a corresponding one of the electric magnets such that magnetic fields created by the electric magnets when the electric magnets are selectively energized provide an attractive force which pulls the piston assembly toward the corresponding electric magnet so as to impart reciprocating mechanical energy to the piston assemblies;

wherein each of the piston assemblies comprises:

a piston rod having a first end and a second end, the first end journaled to the crankshaft; and

a piston head fabricated of a ferrous material, the piston head pivotally connected to the second end of the piston rod to define a first pivot point and pivotally connected to the support structure to define a second pivot point such that the piston head travels between a first position and a second position along an angular path about the second pivot point.

6. The engine of claim **5**, wherein the support structure is a platform having an open upper face, and wherein the crankshaft is connected to the open upper face of the platform.

7. The engine of claim **5**, wherein in the first position the piston head is in a face-to-face relationship with the electric magnet and wherein in the second position the piston head is angularly disposed relative to the electric magnet.

8. The engine of claim **5**, wherein the piston rod is pivotally connected to the piston head at a location diametrically opposed to where the piston head is pivotally connected to the support structure.

* * * * *